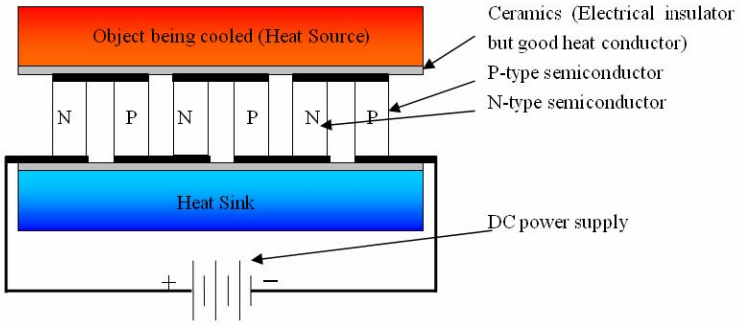
Air-Conditioning and Refrigeration Technology Institute

Project Summary

Thermoelectric Technology Assessment

Most air-conditioning and refrigeration systems use a vapor compression cycle. While this cycle is very efficient, the system has moving parts and uses refrigerants that cause environmental concerns if leaked.



Thermoelectric cooling is a solid state technology which uses no refrigerant and as such offers a quiet alternative to conventional vapor compression cooling technology. In a thermoelectric system, semiconductor elements and a DC power source take the place of a compressor and refrigerant; the conventional system evaporators are replaced by finned or fluid cooled heat sinks. Although recent advances have been made in improving the energy efficiency of thermoelectric cooling devices, the technology is still less energy efficient than traditional vapor compression systems used in mainstream residential and commercial HVAC&R applications. The technology is currently limited to relatively small cooling capacities and temperature lifts. However, given a breakthrough in materials, in terms of higher performance at low cost, this technology might offer the possibility of a safe, efficient, and affordable alternative to vapor compression equipment.

For this project, the latest information and references were sought on thermoelectric cooling. The analysis suggested that enhanced materials still need to be developed to realistically employ thermoelectric technology in large scale air-conditioning and refrigeration systems. The development of nanostructures offers one possibility to provide enhanced materials to increase the efficiency of thermoelectric coolers.

Contractor: University of Maryland, College Park, MD
Principal Investigators: Bao Yang, Ph.D. and Reinhard Radermacher, Ph.D.
Start-date: 1 June 2006; End-date: 31 December 2006
The project final report, ARTI Report Number 101200-01, May 2007, is posted on the ARTI website, www.arti-research.org
Revised: 8/02/2007